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EULER EQUATIONS IN MICRO DATA: MERGING DATA FROM TWO SAMPLES

by Annamaria Lusardi

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Annamaria Lusardi

(CentER and Dartmouth College)

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Euler Equations in Micro Data: Merging Data from Two Samples.

Abstract

This paper uses a generalization of the instrumental variables estimator to analyze the rational expectations-permanent income model when data come from two samples. This generalization is derived from the method of moments estimation and is equivalent to generalized least squares with a particular weighting matrix. Consumption data is taken from the US Consumer Expenditure Survey, which provides information on total household expenditure. Income data is taken from the US Panel Study of Income Dynamics. The use of two data sets improves substantially the empirical analysis of the permanent income model in micro data. The problem of measurement error both in consumption and income data can be carefully considered and the low power of tests of the permanent income hypothesis against a specific alternative can be partially solved.

My findings show that Euler equations, i.e. the first order conditions of consumers' maximization problem, are rejected for food consumption, for a measure of consumption which includes the lowest amount of durable goods, i.e. strictly nondurable consumption, and for nondurable consumption.

Annamaria Lusardi
CentER for Economic Research
Tilburg University
P.O. Box 90153
5000, LE Tilburg
The Netherlands
Tel: 31-13-662718
Fax: 31-13-663066

1. INTRODUCTION.

The empirical research on the rational expectations-permanent income models is extensive and so far many works have used household data to study the Euler equations, i.e. the first order conditions of the consumer's maximization problem. The evidence on micro data has given mixed results on the failure of the theoretical predictions and, in particular, on the existence and quantitative importance of liquidity constraints.

The work on micro data has been carried out using mainly one data set : the Panel Study of Income Dynamics (PSID). While it provides detailed information on labor income, the PSID has limited data on consumption. Only food consumption is reported in the data set and little is known about the reliability of this measure and how well it approximates the expenditure behavior of US consumers. A very detailed and broad measure of consumption is provided in another data set : the Consumer Expenditure Survey (CES). This survey contains data on food, nondurable, semi-durable and durable expenditures. However, it has limited information about income and income data is affected by substantial measurement error. The error in measurement is a crucial problem in micro data sets and it is should be taken into account when assessing the empirical evidence on the permanent income model.

In this paper, I merge data from the PSID and the CES and show that the combination of these data sets allows a better analysis of the permanent income model than previous work based on a single data set. Consumption data from the CES enable me to extend the analysis to a more appropriate expenditure measure than food consumption. Income data from the PSID allow me to correctly evaluate the predictability of future income changes. Furthermore, some assessment of the reliability of the data and the extent of measurement error in some variables is made, and it provides some explanation for results obtained in previous work which used only one of these data sets. Since the data for the estimation come from two samples, I use a generalization of the instrumental variables estimator: two-sample instrumental variables estimator (2SIV). This estimator provides a useful way of dealing with data from outside the sample.

The paper is organized as follows: In part 2, I outline the model to be estimated. In part 3, I describe the 2SIV estimator that will be used to estimate the theoretical model. In part 4, I report the results of the empirical estimation. In part 5, I summarize my findings and conclude.

2. THE RATIONAL EXPECTATIONS-PERMANENT INCOME MODEL IN PANEL DATA.

In the original paper of Hall and Mishkin (1982), the predictions of the rational expectations-permanent income model are tested using panel data from the PSID. They estimate variance-covariance restrictions, i.e. they estimate cross-sectional sample variances and covariances for changes in consumption and changes in income and then solve for the parameters implied by the theoretical model. They find that the data could be better explained by adding to the model "rule of thumb" consumers, who simply consume their current income. The percentage of "rule of thumb" consumers in the PSID is found to be approximately twenty percent.

Hall and Mishkin account for measurement error in the food consumption, but for their model to be identified, they do not account for measurement error in the income measure. However, a lot of the variation in income may simply be given by noise. Altonji and Siow (1987) carefully address this problem and, once they account for measurement error, they could not find evidence against the permanent income model in the PSID.

Other authors have estimated the predictions of the permanent income model using household data. Zeldes (1989) improves substantially on the work of Hall and Mishkin (1982) and proposes a test for liquidity constraints. He splits the sample and examines the behavior of food consumption for consumers more likely to be constrained, e.g. households with low wealth. Using data from the PSID, he finds some support for the existence of liquidity constraints. Runkle (1991) however performs a similar analysis but takes into account measurement error in the food consumption measure in the PSID and he does not find any evidence against the permanent income model.

The empirical work on the permanent income model in US micro data has been almost exclusively carried out on the PSID[1], which provides information only on food consumption. This consumption measure can substantially limit the analysis. Some authors have simply assumed that the utility is additively separable in food and nondurable consumption[2]. Hall and Mishkin (1982) acknowledged that the proportion of income spent on food may decline as income rises and considered a linear Engel curve with a positive intercept. However, to be able to estimate Euler equations using only food consumption, one needs to assume that the residuals from the linear relation are not a function of income changes.

The extent of measurement error in food consumption is an additional problem to be taken into account. Shapiro (1982) calculates that 95% of the variance of the year to year change in food consumption in the PSID is attributable to measurement error. Similarly, Runkle (1991) estimates that, of the variance of food consumption not explained by variation in interest rates, 76% is due to measurement error. There is also a substantial ambiguity in the way the question is formulated in the survey and in the time period the food measure refers to. The question is formulated as follows: "How much do you spend on the food that you use at home in an average week?" The responses are collected in the spring and they may pertain to the first quarter of the interview year instead of pertaining to the past year. Also, it is not clear, for example, whether the head of the household simply recalls what they have spent in recent months and, if they have been constrained only for a limited period last year, whether he or she would accordingly adjust the amount reported in the interview. When first differences are taken in micro data, the problem of measurement error can become dramatic, since the ratio of signal to noise may be quite poor.

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[1] Exceptions are, for example, Carroll (1991), Attanasio and Browning (1991), and Meghir and Weber (1992).

[2] See Zeldes (1989).

The CES contains very detailed data on many consumption items[3]. For example, it collects data on total quarterly household expenditure both for durable and nondurable goods. In another work, I have estimated Euler equations using data from the CES. The parameters of the model are however quite imprecisely estimated given the extent of measurement error in the income data reported in the survey[4]. There are many problems with the income data reported in the CES and the number of incomplete and unreliable reports of income seem to be severe.

This paper will deal with the estimation of Euler equations and the problem of measurement error in a fairly new way. I will merge data from two samples: the CES and the PSID[5]. The CES reports data on total household expenditure and one can substantially improve on the measure of consumption used to estimate the predictions of the permanent income model. However, a serious limitation of the CES is that the income data seem to be affected by substantial measurement error. Also, the CES provides limited information on wages, work characteristics and job status. The PSID, by contrast, provides very detailed data on income and its determinants and it is difficult to think of other data sets that can provide better information on labor income than the PSID, whose principal aim is to collect data on household income. In this paper, I combine consumption data from the CES with income data from the PSID to estimate the predictions of the permanent income model. The use of two data sets has additional advantages; for example, one can evaluate whether previous results in the literature are specific to the sample, or the data considered. In the following section, I derive the Euler equation, i.e. the optimality condition for the allocation of consumption, that is estimated using data from two samples.

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[3] One of the purposes of the data collection is the construction of the Consumer Price Index.

[4] See Lusardi (1992).

[5] Carroll (1991) has also used data from the CES and the PSID to examine whether consumption is sensitive to future income. He does not estimate Euler equations, but considers closed-form solutions for the consumption function when preferences are quadratic. Skinner (1987) has investigated the possibility of improving on the consumption measure reported in the PSID using estimates from the CES, but the measure he considers is limited to few consumption items.

2.1 THE EULER EQUATION.

Consider an individual with a Constant Relative Risk Aversion (CRRA) utility function of the following form:

$$U(C_{it}, \theta_{it}) = \frac{1}{1-a} C_{it}^{1-a} \exp \theta_{it} \tag{1}$$

where i is an index for household, t indicates the time period, a is the coefficient of risk aversion, C represents real nondurable consumption and θ is a taste shifter. Empirically, I assume θ to be a function of age, age squared, family size (FS) and the number of children (NCHILD)[6]:

$$\theta_{it} = b_0 \, age_{it} + b_1 \, age_{it}^2 + b_2 FS_{it} + b_3 \, NCHILD_{it} + b_i + u_{it} \tag{2}$$

Tastes include an individual component b_i, which captures unobservable factors relevant to a household, while u_{it} represents the idiosyncratic shock to consumer tastes. The Euler equation for household i between time t and t+1 can be easily derived by the usual perturbation argument:

$$U'(C_{it}, \theta_{it}) = E_t \left[\frac{U'(C_{it+1}, \theta_{it+1})(1+r_{it})}{(1+d_i)} \right] \tag{3}$$

where r_{it} indicates the risk-free interest rate between t and t+1, d_i is the rate of time preference and U' denotes the partial derivative of U with respect to C . Rewrite the Euler equation in the following way:

$$\left[\frac{U'(C_{it+1}, \theta_{it+1})(1+r_{it})}{U'(C_{it}, \theta_{it})(1+d_i)} \right] = 1 + \epsilon_{it+1} \tag{4}$$

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[6] See also Zeldes (1989).

where ϵ_{it+1} is the expectations error. I assume the error term to be composed of two parts:

$$e_{it+1} = \mu_{it+1} + \nu_{t+1} \tag{5}$$

a truly idiosyncratic term μ_{it1} and a macroeconomic shock ν_{t+1}, which is equal across households. These two components have zero means, are uncorrelated and :

$$\begin{aligned} E(\mu^2_{it+1}) &= \sigma^2_\mu \quad \forall i,t \\ E(\nu^2_{t+1}) &= \sigma^2_\nu \quad \forall t \end{aligned} \tag{6}$$

I also set the interest rate equal to the rate of time preference and consequently these terms drop out of the equation[7]. By substituting the preference specification, taking logs and considering a Taylor approximation[8], one obtains:

$$\ln C_{it+1} - \ln C_{it} = B_0 + B_1\, age_{it} + B_2\, \Delta FS_{it+1} + B_3\, \Delta CHILD_{it+1} + e_{it+1} \tag{7}$$

where

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[7] The data set does not contain information on individual interest rates. One could construct interest rates data from the marginal tax rates. The constructed data gave rise to quite imprecise estimates. In this work, I focus on the investigation of the co-movements between consumption and income changes.

[8] I use the following approximation: $\ln(1+\epsilon) = \epsilon - \epsilon^2/2$

$$
\begin{aligned}
B_0 &= \frac{b_0 + b_1 + \frac{\sigma_\mu^2}{2} + \frac{\sigma_\nu^2}{2}}{a} \\
B_1 &= 2\,\frac{b_1}{a} \\
B_2 &= \frac{b_2}{a} \\
B_3 &= \frac{b_3}{a}
\end{aligned}
\tag{8}
$$

Thus, the growth in consumption depends on the age of the reference person in the household, on the change in the family size (ΔFS) and on the change in the number of children (ΔCHILD). By taking differences, the individual taste component b_i drops out of the equation. The error term has zero mean and becomes:

$$
e_{it+1} = \frac{u_{it+1} - u_{it} - (\mu_{it+1} + \nu_{t+1}) + \frac{\mu_{it+1}^2}{2} + \frac{\nu_{t+1}^2}{2} - \frac{\sigma_\mu^2}{2} - \frac{\sigma_\nu^2}{2}}{a} \tag{9}
$$

By the assumption of rational expectations, any variable known at time t, e.g. Z_{it} , should be orthogonal to the expectations error[9]. This is the condition that will be used in the empirical estimation.

2.2 EULER EQUATIONS WITH "RULE OF THUMB" CONSUMERS.

Consider a more general case where, as in Hall and Mishkin (1982), there are consumers who simply consume their current income. The marginal propensity to consume out of current income

[9] The set of instruments Z_{it} has to be chosen carefully. Given the specification of individual preferences, one period lagged consumption cannot be used in the test of the orthogonality condition.

for "rule of thumb" consumers is unity[10]:

$$C_{it} = Y_{it} + \xi_{it} \tag{10}$$

Let λ be the fraction of "rule of thumb" consumers in the population. The model to be estimated is a weighted average of permanent income consumers - who consume according to the Euler equation derived in equation (7) - and "rule of thumb" consumers, who simply consume their current income. The population mean of consumption growth can be written as:

$$\begin{aligned} E[\,lnC_{it+1} - lnC_{it}] = E[\beta_0 + \beta_1\, age_{it} + \beta_2 \Delta FS_{it+1} + \beta_3\, \Delta CHILD_{it+1} + \\ + \beta_4 (lnY_{it+1} - lnY_{it}) + e_{it+1}\,] \end{aligned} \tag{11}$$

where the coefficients $\beta_0, \beta_1, \beta_2, \beta_3$ are similar to the coefficients in equation (7) but are multiplied by $(1 - \lambda)$ and e'_{it+1} contains also the error term of equation (10). I interpret β_4 as a measure of the "sensitivity" of consumption to predictable income changes[11]. Let income growth be written in the following way:

$$lnY_{it+1} - lnY_{it} = \alpha_0 + \alpha_1 Z_{1it} + \alpha_2 Z_{2it} \ldots + \alpha_n Z_{nit} + \eta_{it+1} \tag{12}$$

I assume that the error term in the income prediction equation is composed of two parts:

$$\eta_{it+1} = n_{it+1} + m_{t+1} \tag{13}$$

n_{it+1} represents the idiosyncratic shock to income changes and includes measurement error if income is not measured correctly, while m_{t+1} represents the effect of macroeconomic shocks.

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[10] Alternatively, one can assume that there are Keynesian consumers who consume a constant fraction of their current income.

[11] Using aggregate data, Flavin (1981) shows that consumption is "excessively sensitive" to income.

The permanent income hypothesis predicts that the coefficient β_4 in equation (11) can only be significant for the unpredictable part of the change in income, while the change in income which can be predicted using variables known at time t should not be correlated with the change in consumption between t and t+1. Note that, even though the econometrician does not know all the information available to individual consumers, the rational expectations hypothesis implies that the predictable change in income, even when based on a subset of the total information available to consumers, must be statistically insignificant[12].

The predictability of income changes is crucial in the estimation of Euler equation with "rule of thumb" consumers. Estimates can be very unreliable and indeed misleading when the instruments are only weakly correlated with the right-hand-side variables[13]. Since what is needed for the test of the Euler equation is a measure of the predictable component of income changes, nothing prevents the estimation of income changes using a different data set. If reliable information on household income can be obtained, one could powerfully test the predictions of the permanent income model. A generalization of instrumental variables estimation will be used to estimate Euler equations when income data come from outside the sample and its derivation is provided in the following section.

3. TWO SAMPLE-INSTRUMENTAL VARIABLES ESTIMATION.

The Two Sample-Instrumental Variables estimator is a generalization of the IV estimation and it is derived using the method of moments approach[14] . In this section, I report its derivation and show how it can be applied to this problem. Consider the following model :

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[12] As in the literature on efficient markets, it is only the "weak rationality" hypothesis that will be tested. See, for example Fama (1970).

[13] See also Nelson and Startz (1990).

[14] See J. Angrist and A. Krueger (1992) for the derivation of the 2SIV estimator and its asymptotic properties and Arellano and Meghir (1992) for the derivation of a similar estimator in a minimum distance framework.

$$Y_i = X_i\,\beta + u_i \qquad i=1,2,3....n \tag{14}$$

The data consist of a single sample of size n, assumed to be i.n.i.d and containing observations on Y_i, X_i and Z_i. The regressors and the error term are correlated, but there exists a set of instruments Z such that:

$$\frac{Z'u}{\sqrt{n}} \sim N\,(0,\Omega\,)$$

$$\operatorname{plim}\frac{Z'X}{n} = \Sigma_{zx} \tag{15}$$

where Ω is non singular and Σ_{zx} is bounded and of full column rank. A Generalized Method of Moments (GMM) estimator can be derived by the minimization of the following quadratic form:

$$m_n(\beta) = n\,f_n\,(\beta)'\,\Omega^{-1}\,f_n\,(\beta) \tag{16}$$

where:

$$f_n\,(\beta) = \frac{Z'\,(Y - X\,\beta\,)}{n} \tag{17}$$

This method simply exploits the moment condition $E(Z'u)=0$ in an optimally weighted quadratic form. The estimator will be:

$$\beta_{gmm} = (X'Z\,\Omega^{-1}\,Z'X)^{-1}\,X'Z\,\Omega^{-1}\,Z'Y \tag{18}$$

with limiting distribution:

$$\sqrt{n} \quad (\beta_{gmm} - \beta) \sim N(0, (\Sigma'_{zx} \Omega^{-1} \Sigma_{zx})^{-1}) \tag{19}$$

The estimator above is equivalent to an Instrumental Variables estimator. The IV estimation can be thought of as arising from Generalized Least Square applied to the transformed model:

$$\frac{Z'Y}{n} = \frac{Z'X}{n} \beta + \frac{Z'u}{n} \tag{20}$$

which will give the same estimator as in equation (18). It is useful to think of the IV estimator as a function of two sets of sample moments: the first set consists of Z'Y/n, the cross product or covariance matrix for instruments and the dependent variable. The second set consists of Z'X/n , the cross product or covariance matrix for instruments and regressors. The case where Z'Y/n is estimated in one sample and Z'X/n in another sample gives rise to 2SIV. If the correlation between instruments and the regressors in one data set is a consistent estimate for the population sampled in the other data set, then the two-sample estimator will have properties similar to those of conventional IV estimators[15]. The moment restriction when data come from samples 1 and 2 must take into account that sample sizes may be different. Equation (16) is now rewritten as:

$$g_n(\beta) = \frac{Z_1'Y_1}{n_1} - \frac{Z_2'X_2\beta}{n_2} = \frac{Z_1'Y_1}{n_1} - (\frac{\sqrt{n_1}}{\sqrt{n_2}}) \frac{Z_2'X_2\beta}{\sqrt{n_1}\sqrt{n_2}}) \tag{21}$$

The suffixes 1 and 2 refer respectively to sample 1 and sample 2. The quadratic form to be minimized is the following:

[15] See Angrist and Krueger (1992) for the assumptions underlying 2SIV estimation.

$$M_n(\beta) = n_1 \, g_n(\beta)' \, \Phi^{-1} \, g_n(\beta) \tag{22}$$

where Φ is the covariance matrix of $\sqrt{n_1}\, g_n(\beta)$. The minimization of (22) yields the 2SIV estimator:

$$\beta_{2siv} = \left[\frac{X_2' Z_2}{n_2} \Phi^{-1} \frac{Z_2' X_2}{n_2} \right]^{-1} \frac{X_2' Z_2}{n_2} \Phi^{-1} \frac{Z_1' Y_1}{n_1} \tag{23}$$

The estimator can be thought of deriving from a GLS regression of $Z_1'Y_1 / n_1$ on $Z_2'X_2 / n_2$ using Φ^{-1} as the weighting matrix[16]. Its limiting distribution is:

$$\sqrt{n_1}\,(\beta_{2siv} - \beta) \sim N(0, \Psi) \tag{24}$$

and

$$\Psi = (\Sigma_{zx}' \, \Phi^{-1} \, \Sigma_{zx})^{-1} \tag{25}$$

The over-identification test statistic for 2SIV is the minimized value of the quadratic form (22) and is distributed as a chi-square with r-q degrees of freedom, where r is the number of instruments and q the number of regressors. The over-identification test measures the correlation between the instruments and the error term and is a specification test for the assumptions underlying the IV estimation.

This estimator allows me to estimate Euler equations using data from two samples. Consumption data is taken from the CES while income data is taken from the PSID. In order to match moments from different samples, one needs a common set of instruments in the two samples. Household characteristics and variables such as education and occupation groups are present in both samples.

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[16] The weighting matrix has to be estimated and requires the knowledge of the parameter β. An iterative procedure will be followed until convergence is achieved.

Given a common set of instruments, it is possible to estimate the first moment, i.e. the covariance between consumption changes and instruments, using CES data and the second moment, i.e.the covariance between income changes and instruments, using data from the PSID.

4. EMPIRICAL ANALYSIS.

4.1 DESCRIPTION OF THE SAMPLES.

Table 1 provides some basic statistics describing the CES sample. The total number of observations is 9568, which are distributed across seven occupation groups. The sample is considerably concentrated on the white population and in 67 percent of the cases the reference person is male. The average family size is 2.77 and in 23.9% of the cases the household is composed of only one person; 61.3 percent of families in the sample do not have children and the mean number of children is 0.72.

Table 2 compares these statistics with data from the PSID[17]. The set of instruments has to be common to both samples and it is useful to determine whether the two samples represent the same population. The distribution of occupation and education groups is very close in the two samples; similar results hold for households' characteristics such as family size, age and marital status of the head of the household or of the reference person. The fraction of male headed households is greater in the PSID because the reference person in the CES does not necessarily coincide with the head of the family[18]. Not only the first moments, but also the second moments are similar between the two samples.

Table 1 shows that many households do not hold any financial assets. The percentage of

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[17] For a complete description of the samples and of the variables under consideration see the appendix.

[18] See data appendix.

households holding no assets is 17% and that the median amount of assets held is very low, i.e. 1500 dollars. This finding is consistent with the evidence of other works, that show that the amount of assets held before retirement is usually quite low in the US. This fact is important per se and may provide some support for the existence of simple "rule of thumb" consumers in the economy. Table 1 reports also labor income and total quarterly expenditure in the CES. They are the focus of the analysis and will be examined in detail in the following sections.

4.2 CONSUMPTION DATA FROM THE CES.

The Consumer Expenditure Survey reports the total amount households spend on durable and nondurable goods in each quarter. From the reported total quarterly expenditure, one needs to define total nondurable expenditure. I have used two definitions for nondurable expenditure. The definition of nondurables and services as given in the National Income and Product Accounts (NIPA) is referred to as "nondurable expenditure". One drawback of this definition is that it includes goods which can be considered durables or semi-durables; shoes and clothes, medical services and education expenses, for example, are included in this measure. If expenditure has some durable components, there is an additional moving average component in the error term of the Euler equation and the estimates may be biased since the instruments can be correlated with the error term. I have therefore used another definition of nondurable expenditure, which includes the lowest amount of durable goods, i.e. "strictly nondurable expenditure"[19]. An additional advantage of this measure is that it represents consumption rather than expenditure of good and services. To match the food measure reported in the PSID, food consumption refers to the sum of food and alcoholic beverages at home and outside home.

The distribution of food, strictly nondurable and nondurable consumption is summarized in figure

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[19] See data appendix. When using aggregate data from the National Income and Product Accounts, Blinder and Deaton (1985) also re-define the measure of consumption to exclude some semi-durable goods.

1, where I provide kernel estimations[20] of the three consumption measures. As expected, food consumption is quite concentrated around its mean, which is approximately 900 dollars. The other two measures of consumption show a more dispersed distribution and, as expected, nondurable consumption has the biggest variance. Some of the variability in this measure however may simply be accounted for by the fact that semi-durables goods are purchased infrequently.

The composition of total quarterly expenditure can be considered in more detail by looking at table 3. The mean and median value of nondurable consumption in a reference year are respectively 2597 and 2242 dollars[21]. Nondurable consumption represents approximately 60% of total quarterly expenditure. Durable expenditure is the most volatile component of total expenditure and it represents the residual 40% of total expenditure. Strictly nondurable consumption represents 47% of total quarterly expenditure, while food consumption represents approximately 20% of total quarterly expenditure.

The important issue for the estimation of Euler equations is however how food relates to other measures of consumption. Figures 2 and 3 show the relation between nondurable consumption, strictly nondurable consumption and food consumption obtained by fitting a cubic spline through the median values of food and nondurable consumption divided in small intervals. From these figures, it appears that there exists a log-linear relation between food changes and strictly nondurable or nondurable consumption changes. The shape of the function at the extreme points can be explained by the small number of observations for which consumption changes in logs are greater than 1.2 or lower than -1.2. Those studies, e.g. Hall and Mishkin (1982), positing a linear relation between food and nondurable consumption in first differences may get incorrect inferences from the estimation of Euler equations using only food consumption.

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[20] I would like to thank John Budd for his help in deriving non-parametric estimation of density functions. The Epanechnikov fixed band-width used in the estimation is 250.

[21] I have considered only one year to minimize the role of price variation.

4.3 INCOME DATA FROM THE PSID.

The income variable reported in the CES corresponds to total disposable income, net of all taxes. It includes mainly labor income, unemployment compensation, retirement pensions and Social Security benefits. Unfortunately, there are three main problems with the income data. First, underreporting and incomplete reports of income are frequent and severe. When reports of income are classified as incomplete, zero or very low values can be found in the data and there are many such values. Secondly, to maintain respondent confidentiality, income above a certain critical value has been replaced by a predetermined value. Consequently, income has been censored at 75,000 dollars until 1982 and at 100,000 dollars subsequently[22]. When there are these problems for income in levels, taking first differences makes income changes undergo huge and artificial variations. As a result, it has been difficult to find instruments which are able to predict income changes; age-earnings profiles across different occupation or education groups reported in other studies are not clearly detected in CES data. More important, there is also one quarter overlap in the report of income, since consumers are asked information about income in the past twelve months in the second and fifth interviews and there is only a nine-month difference between these two interviews. This fact tends to reduce the power of the test in favor of the permanent income model, since an income shock arising in the quarter of overlap will not be reported in the difference in income, while consumption may adjust to the different level of income. Also, taking income changes over a 9-month interval makes the predictability of income changes quite difficult to evaluate.

Table 4 shows some basic statistics - adjusted R^2 and F values - summarizing the predictability of income growth using CES and PSID data. Age-earnings profiles for different education or occupation groups can be detected from the PSID data, and variables such as the composition of

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[22] More precisely, the income measure is topcoded (i.e.when income reaches a certain amount, it is set to a specific value) at $ 75,000 in 1980-81 and set to zero; it is topcoded and set at the topcoded value of $ 75,000 in 1982 while topcoded and set at the topcoded value of $ 100,000 from 1983 to 1987.

earners in the household, family size or workers' characteristics have some predictive power. The adjusted R^2 for the regression of income changes on the instruments is approximately 0.01[23]. This measure is consistent with the estimates of other studies which use data in first differences[24]. The same instruments have little predictive power when the income measure is taken from the CES. The adjusted R^2 of the regression of income changes on the instruments using CES data is rarely above 0.003. In the last row of table 4, I have used lagged income to predict income growth. Lagged income seems to explain a large part - 12 percent - of the variation in income growth in the CES. Using PSID data, lagged income explains only 3 percent of the variation in income growth. This result is consistent with the presence of severe measurement error in the income data reported in the CES.

These findings can be explained by looking at the income measures reported in the two data sets. Tables 5 and 6 report household income in levels and in first differences across different percentiles. In the original sample in the CES, I have excluded self-employed and farmers but no other adjustment has been considered. In the PSID sample, I excluded the "poverty" sub-sample and minor and major incomplete reports of income. Approximately ten percent of the sampled families in the CES report a very low income, i.e. 1000 dollars, or zero income. In the final sample I selected, I excluded all the zero values as well as incomplete reports of income in both interviews. Outliers detected from plots of the data have also been deleted. The selected sample shows values much closer to the ones reported in the PSID, but still quite lower. Note however that the sample has been reduced by more than 30%. Table 6 shows CES and PSID data in first differences. If some errors were reported consistently in both interviews, first differences might cancel them out. In fact, first differences are bigger in the CES data and the error measurement problem is even more dramatic.

To overcome the severe measurement error of income data in the CES, I will use data from the

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[23] In the estimation of the model, I first regress consumption and income growth on demographics and time dummies to account for taste changes and macroeconomics shocks The residuals from these regressions are then used to determine the predictability of the instruments.

[24] See, for example, Altonji and Siow (1987).

PSID. As previously shown, the sample distribution is similar in the two data sets and there exists a common set of instruments, such as household characteristics and education and occupation groups, that allows me to combine the data from two samples.

4.4 EMPIRICAL RESULTS FROM 2SIV ESTIMATION.

Table 7 reports the results of the estimation of Euler equations with "rule of thumb" consumers using data from two samples. The consumption measure is taken from the CES in the period 1980-87 and it refers to nondurable consumption. The income data is taken from the PSID in the same sample period. The 2SIV estimation is performed using several sets of instruments and in the second and third columns of table 7, the adjusted R^2 and the F values of the regression of income changes on the instruments are reported to check the predictive power of the instruments. The fourth column reports the estimates of the parameter β_4 in equation (11) using the 2SIV estimator. The minimized value of the quadratic form is reported in the last column together with its significance level as a test of the over-identifying restrictions. The fifth column shows the estimates of the parameter β_4 obtained by a 2-step procedure; I first estimate income changes from the PSID and then use the estimated parameters to predict income changes in the CES. I then regress consumption changes on those predicted income changes. The estimates can be compared with the ones obtained using 2SIV. While least squares use the identity matrix as wheighting scheme, 2SIV estimator uses an optimal weighting scheme, with more weight being given to moments which are estimated more precisely.

The set of instruments in the fist row is represented by workers' characteristics: marital status, sex, race and household composition. I then consider education and occupation dummies interacted with the age variable to capture age-earnings profiles in different education and occupation groups. Carroll and Summers (1991) have shown that consumption tracks income very closely across different occupations and education groups. If labor income can be predicted and their findings are robust[25], one expects to find a relation between consumption and predicted income changes. I have used also different combinations of instruments and, in line 6, I report the estimates using all the instruments. In the last row, I have used lagged income to predict income changes. Other researchers have relied on this variable to test the permanent income model and it may be useful to consider it to be able to compare results. However, in the presence of measurement error in income, lagged income is not a valid instrument.

The 2SIV estimated value of the parameter β_4 for nondurable consumption lies around a value of 0.2-0.3 and it is statistically significant when a large set of instruments is used to predict income changes. Note that when the instruments are only weakly correlated with income changes, e.g. in row 1, the coefficient is not statistically significant. However, the test has little power in this case. In the last row, the coefficient β_4 is smaller than when other instruments are used and is not statistically significant. Comparing the results of 2SIV with the 2-step estimates, one can see that the estimates are close and in particular that the standard errors are very similar. The fact that standard errors are sometimes lower in the 2SIV than in the 2-step estimator case may be explained by the different weighting matrix. In the 2SIV case, the weights are optimal with more weight being given to instruments for which the moments conditions are estimated more precisely. The minimized value of the quadratic form from which the 2SIV has been derived shows that one cannot reject the over-identifying restrictions at the 10% confidence level.

Considering the case of strictly nondurable consumption in table 8, one can see that the estimated β_4 lies around a value of 0.4 and it is statistically significant, apart from the first row when the instruments do not have a lot of predictive power. The estimates obtained by using 2-step or 2SIV give again very similar results. In both cases, the rational expectations-permanent income model is rejected are there exists evidence that consumption is "excessively" sensitive to income. The over-

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[25] Carroll and Summers (1991) do not provide a formal test of the Euler equation. Also they do not account for the effects of demographics and taste shocks, which may be very important in explaining the close movement between consumption and income.

identifying restrictions cannot be rejected at a level of significance lower than 40%.

The results for food consumption are reported in table 9. One obtains a slightly higher value for β_4 than for strictly nondurable consumption, but also higher standard errors. The coefficient is statistically significant for every set of instruments both in the 2SIV estimation and the 2-step case. The overidentifying restrictions cannot be rejected at the 20% level of significance.

It is useful to compare these estimates with those obtained using only CES data. Table 10 reports the PSID-CES estimates of the parameter β_4 using 2SIV estimator and the CES estimates using two-stage least squares estimates. The coefficients are quite different, not only in magnitude but also in their statistical significance. Using CES data, the estimates of the parameter β_4 are always lower than in the CES-PSID case and they are not statistically significant. Note however that they follow the same patter and the coefficient β_4 tends to be higher in the case of strictly nondurable and food consumption. Note also that, as already shown in table 4, the predictive power for income growth using CES data is always very low.

Since the income data is taken from the PSID, it is not necessary to exclude the observations in the CES with incomplete reports of income. While there may be some correlation between noisy reports in consumption and income, using the original CES sample enables the analysis to be carried out in a much bigger sample. It is also useful to check whether results are sensitive to the chosen sample and to the exclusion criteria. Selection criteria vary widely among previous empirical work. Hall and Mishkin (1982) exclude only the families whose responses to the food and income questions were not deemed accurate by the interviewer. Altonji and Siow (1987) exclude observations if real food expenditure rose by more than 400 percent or fell by 75 percent from the preceding year and if the real wage or real family income rose by more than 500 percent or fell by more than 80 percent[26]. Zeldes (1989) excludes an observation if the level of consumption rises (or falls) by a factor of 3. With respect to Zeldes, Runkle (1991) uses more stringent data selection criteria. He

[26] Note, however, that Altonji and Siow do not exclude the poverty sub-sample of the PSID.

excludes observations if food consumption grew by more than 300 percent or shrank by more than 75 percent. He also excluded farmers and self-employed head of household. Sample selection proved to be an important issue and it may be responsible for the results of the empirical work. Altonji and Siow mentioned in their paper: ".... when we drop the sample selection requirement that valid data be available on all of the various income determinants used in the analysis the sample size more than double, and in the larger sample the relationship between the lagged income changes and consumption is statistically significant".[27] Also, the discrepancy in the empirical evidence provided by Zeldes and Runkle is difficult to interpret. Their samples, for example are very different and Zeldes uses a much larger data set[28].

Table 11 compare 2SIV estimates from the CES final sample to the 2SIV estimates when the original CES data set - which excludes only incomplete reports of consumption - is used in the estimation. Very similar estimates are obtained using an enlarged sample. As expected, the standard errors are smaller and the estimates more precise. The estimated values of the parameter β_4 indicate that the Euler equations are rejected and that consumption is sensitive to predictable income changes. For nondurable, strictly nondurable and food consumption there exist evidence of "excess sensitivty", in particular when a large set of instruments is used to predict income growth.

Both the CES and PSID samples include retired households; there have been no exclusion criteria for old households. However, it may be difficult to evaluate the predictions of the rational expectations-permanent income model for very old households. The uncertainty of the remaining life-span may be very relevant for those cases. Also, the composition and changes in expenditure may be quite different for those people. Health expenditure, for example, may represent a big share of total nondurable consumption and there may exist physical constraints to enjoy goods and services

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[27] Altonji and Siow (1987), pag. 132.

[28] This fact is not due only to more stringent data selection. Runkle did not consider PSID data before 1973.

such as transportation or eating out[29]. I have estimated Euler equations excluding the people above the age of 65 both in the CES and in the PSID. The estimates are reported in the last columns of table 11. They show that the Euler equations are rejected even when old households are excluded and there are no dramatic changes in the parameter measuring the sensitivity of consumption to predictable income changes.

In an interesting paper, Carroll (1991) estimates whether consumption depends on expected future income. He uses consumption data from the CES and estimates future income using data from the PSID. His findings suggest that consumption is not sensitive to future income once current income has been taken into account. In his work, he considers long-term effects of consumption and income. In this work I concentrate on the short terms effect and the two results seem to be consistent. Both in the short and in the long run, consumption is too "sensitive" to current income.

5. CONCLUSIONS.

In this paper, I have estimated Euler equations combining data from the CES and the PSID. The use of two data sets which provide so much information on consumption and income measures allows me to carefully evaluate the predictions of the permanent income model in panel data. Data from the PSID enable me to examine and assess the predictability of income changes, while data from the CES enable me to enlarge the analysis to a better measure of household consumption than food consumption. The estimation of Euler equations using data from two samples is made possible by a generalization of the instrumental variables estimator, the two-sample instrumental variables estimator. This estimator is derived from the method of moments estimation and it is equivalent to generalized least squares with a particular weighting matrix.

I found that Euler equations derived from the rational expectations-permanent income hypothesis are strongly rejected for strictly nondurable consumption, food consumption and also

[29] See also Börsch-Supan and Stahl (1991).

nondurable consumption as defined in the NIPA, in particular when a large set of instrumensts is used to predict income changes.

The Two-Sample Instrumental Variables estimator provides an innovative way of dealing with poor and noisy data. The availability of information from different data sets can and should be exploited and may enable the researcher to better compare the theory with the empirical evidence.

DATA APPENDIX.

Description of the samples.

The estimation is performed by using consumption data from the quarterly interview panel survey of the Consumer Expenditure Survey and income data from the Panel Study of Income Dynamics in 1980-1987.

CES

Each sample household in the CES is interviewed once per quarter for five consecutive quarters. In the initial interview information is collected on demographics and family characteristics and on the inventory of major durable goods. The second through fifth interview use uniform questionnaires to collect expenditure data in each quarter. Wages, salary and information on the employment status of each household member is collected in the second and fifth interview. In the fifth and final interview an annual supplement is used to obtain a financial profile of the household.

Given the structure of the data, I will consider consumption as reported in the second and fifth interview, since for those interviews income data is also reported. In my sample I merge consumers whose final interview happens in the first quarter of 1981 with consumers whose final interviews are respectively in the second, third and fourth quarter of 1981. Due to changes in the data collection, I merge other waves of consumers only from the first quarter of 1983 to the fourth quarter of 1983, from the first quarter of 1985 to the fourth quarter of 1985 and finally from the first quarter of 1987 until the fourth quarter of 1987. The sample covers sixteen quarters which corresponds approximately with eight years of data.

The sample is composed of 9,568 observations. I exclude the households whose heads are self-employed or in farm, forestry and fishing occupations since their income and consumption are underestimated or not reported correctly. A consumer is included in the sample only if consumption is reported in each interview.

PSID

Each household in the PSID is interviewed once per year and the same family and their "split-offs" are followed over time. There is a problem of timing for some important variables. Total income, for example, refers to the calendar year prior to the interview, while households characteristics refer usually to the time of the interview , which happens in the spring of each year. There is also a substantial ambiguity concerning what period the food consumption measure refers to. Since the consumption measure is taken from the CES, this problem is avoided in my work.

I exclude the "poverty sample", where low-income families are oversampled. Since the income measure is the one of interest, I also exclude households which are self-employed since their report is usually underestimated. I exclude as well minor and major data allocations for income. As for the CES, I deleted the farmers from the sample, since it is not simple to distinguish their home production and consumption. Also, an observation would be deleted if there are major family composition changes or split-off in subsequent years, since it is difficult to interpret the changes in income in those cases. Occupation and education groups have been defined in order to match the definitions provided in the CES.[30]

Description of the variables.

The consumption measure referred to as "strictly nondurable consumption" has been derived by summing the CES quarterly expenditure on food, alcoholic beverages, tobacco, utilities, personal care, household operations, public transportation, gas and motor oil and miscellaneous expenses. The nondurable measure corresponds to consumption as previously derived with the addition of apparel and services, expenditure on health, education and reading. CES food consumption refers to the sum of food consumption and alcoholic beverages inside and outside the house. In the PSID, this is the measures of food consumption which is reported.

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[30] I would like to thank Bill Passero at the Bureau of Labor Statistics for providing me with the data necessary to match occupations between the CES and the PSID.

The income variable in the PSID refers to total family income, which is the sum of taxable income of head and spouse, total transfers to head and spouse, taxable prorated income of others, total prorated transfers to others. From this measure, total estimated federal income taxes of head, spouse and all extra earners have been subtracted.

All variables have been deflated by the corresponding seasonally unadjusted Consumer price Index. Both the change in income and in consumption refer to the change in logarithms or the growth rate. Using logs can partially cure the problem of heteroscedasticity. Also, plots of the data have shown potential outliers in the measure of consumption, income and assets which have been deleted from the sample.

The characteristics of consumers in the CES, like marital status, age or occupation refer to the "reference person" in the household, which is identified with the person who owns or rents the house. If there is joint ownership, the reference person is the first person mentioned by the respondent when asked to "start with the name of the person or one of the persons who owns or rents the home". In the PSID, all characteristics refer to the head of the household.

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Table 1

Basic Statistics

Age of Reference Person, mean	47	Family Size, mean	2.77
Reference Person White, mean	0.85	Number of Children in the Household, mean	0.72
Reference Person Male, mean	0.67	Number of Earners in the Household, mean	1.40
Occupation of Reference Person:		Number of Young Households below 30, mean	0.19
Managerial & Prof. Specialty	0.27	Number of Cars in the Household, mean	1.32
Technical, Sales & Admin. Support	0.14	House Ownership, mean	0.67
Service Occupation	0.07	Annual Labor Income, 2nd interview, mean	21,332
Precision, Craft & Repair Occup.	0.08	Annual Labor Income, 5th interview, mean	22,058
Operators, Fabric & Laborers	0.14	Total Quarterly Expenditure, 2nd interview, mean	4,789
Retired	0.16	Total Quarterly Expenditure, 5th interview, mean	4,737
Not Working	0.14	Median Value of Household Assets	1,500
Number of observations	9568	Households with no Assets, mean	0.17

The reference person in the CES refers to the person who owns or rents the home.

Source: Consumer Expenditure Survey 1980-87.

Table 2

Comparison of Data Between the CES and the PSID

	CES	PSID
Age	47.378 (17.305)	45.175 (16.952)
White	0.854 (0.353)	0.895 (0.301)
Male	0.672 (0.469)	0.774 (0.417)
Married	0.609 (0.488)	0.703 (0.457)
Family size	2.768 (1.586)	2.795 (1.428)
Children	0.721 (1.099)	0.892 (1.145)
Manager. & Profes.	0.269 (0.443)	0.278 (0.448)
Technic, Sales & Adm.	0.146 (0.353)	0.109 (0.312)
Service	0.074 (0.262)	0.058 (0.234)
Precis., Craft & Rep.	0.087 (0.282)	0.151 (0.358)
Operat., Fabr. & Lab.	0.146 (0.353)	0.141 (0.348)
Retired	0.167 (0.373)	0.158 (0.364)
Less than High School	0.141 (0.348)	0.134 (0.340)
High School	0.304 (0.460)	0.355 (0.478)
Less than College	0.203 (0.402)	0.184 (0.388)
College	0.109 (0.312)	0.148 (0.355)
More than College	0.099 (0.299)	0.064 (0.245)
Weeks of work	34.23 (23.101)	34.13 (21.211)
# of observations	9568	14665

This table reports means and standard deviations (in parentheses) of the variables listed in the first column.

Source: Consumer Expenditure Survey and Panel Study of Income Dynamics, 1980-1987.

Table 3

Composition of Total Quarterly Expenditure in the CES

	Mean (s.d.)	Median
Total Quarterly Expenditure	4845 (3867)	3875
Nondurable Expenditure	2597 (1635)	2242
Strictly Nondurable Expenditure	1973 (1220)	1744
Food Expenditure	905 (607)	780
Durable Expenditure	2226 (2770)	1479
Nondurable / Total Expenditure	0.608 (0.180)	0.611
Strictly Nondurable / Total Exp.	0.472 (0.163)	0.467
Food / Total Expenditure	0.221 (0.108)	0.205
Durable / Total Expenditure	0.404 (0.174)	0.396

Source: Consumer Expenditure Survey, 1985:1-1985:4.
Number of observations: 2485.

Table 4

Predicted Income Changes in the PSID and in the CES

Regr. List	Pred. $\Delta \ln Y$ in the PSID		Pred. $\Delta \ln Y$ in the CES	
	Adj R^2	F value	Adj R^2	F value
Z1	0.003	6.504 (0.0001)	0.0008	1.953 (0.048)
Z2	0.005	6.291 (0.0001)	0.0009	1.603 (0.070)
Z3	0.007	10.023 (0.0001)	0.0014	2.111 (0.013)
Z4	0.009	9.515 (0.0001)	0.0015	1.871 (0.018)
Z5	0.009	7.990 (0.0001)	0.0017	1.838 (0.012)
Z6	0.010	7.922 (0.0001)	0.0019	1.752 (0.013)
Z7	0.030	525.540 (0.0001)	0.1265	1384.6 (0.000)

This table reports adjusted R^2 and F values (significance levels are in parentheses) from the regression of the residuals of income growth (income growth has been regressed first on demographics and period dummies) on the instruments Z listed in column 1 using PSID and CES income data.

The variables used to predict income growth are the following:
Z1 - 8 dummies for marital status, sex, race, families with children, singles, composition of earners in the household;
Z2 - Z1 + 3 education dummies and education dummies interacted with age;
Z3 - 6 occupation dummies and occupation dummies interacted with age;
Z4 - education and occupation dummies interacted with age;
Z5 - Z3 + Z1 ;
Z6 - all instruments ;
Z7 - lagged income in logs ;

Table 5

Comparison of Income Measures between the CES and the PSID

	CES original sample	CES selected sample	PSID sample
5 %tile	0	3925	5725
10 %tile	1207	5407	8495
25 %tile	7122	10191	15817
50 %tile	16383	19167	26257
75 %tile	28332	30691	37605
90 %tile	42015	44023	50696
mean (s.d.)	19911 (17663)	22871 (17405)	28267 (17709)
# of obs	13744	9568	14665

This table reports income measures across percentiles between the CES and the PSID. The second column reports the income measure in the CES when no selection was made for incomplete reports of income. The third column reports the income measure in the selected sample in the CES when incomplete and zero income reports were excluded. The last column reports the income measure in the PSID when minor and major data allocations were excluded.

Table 6

Comparison of Income Differences between the CES and the PSID

	CES original sample	CES selected sample	PSID sample
5 %tile	- 18991	- 13518	- 10246
10 %tile	- 10771	- 8486	- 6481
25 %tile	- 3026	- 2513	- 2182
50 %tile	188	292	235
75 %tile	4421	3765	3068
90 %tile	12507	9948	7142
mean (s.d.)	626 (14622)	867 (10970)	362 (7542)
# of obs	13744	9568	14665

This table reports income differences across percentiles between the CES and the PSID. The second column reports the income difference in the CES when no selection was made for incomplete reports in both interviews. The third column reports the income diffrence in the sample finally selected in the CES and adjusted for incomplete and zero income reports in both interviews. The last column reports the income difference in the PSID when minor and major data allocations were excluded.

Table 7

Nondurable Consumption and Predictable Income Changes

Instruments List	Predicted ΔlnY		2SIV	2-step	OVERID Test
	Adj R^2	F value (p value)	β_4 (s.e.)	β_4 (s.e.)	Min M_n
Z1	0.003	6.504 (0.0001)	0.032 (0.245)	0.089 (0.235)	11.455 (0.120)
Z2	0.005	6.291 (0.0001)	0.198 (0.183)	0.209 (0.189)	16.772 (0.210)
Z3	0.007	10.023 (0.0001)	0.182 (0.159)	0.257 (0.162)	12.642 (0.317)
Z4	0.009	9.515 (0.0001)	0.334 (0.146)	0.411 (0.150)	11.745 (0.698)
Z5	0.009	7.990 (0.0001)	0.213 (0.142)	0.267 (0.136)	24.863 (0.165)
Z6	0.010	7.922 (0.0001)	0.280 (0.133)	0.341 (0.139)	22.971 (0.345)
Z7	0.030	525.540 (0.0001)	0.135 (0.123)	0.083 (0.063)	-

This table reports estimates of equation (11) in the text using consumption data from the CES and income data from the PSID. The statistics in colums 2 and 3 are the adjusted R^2 and F values (significance levels are in parentheses) from regressions of income changes on the instruments listed in column 1. Columns 4 and 5 report 2SIV and 2-step estimates of the parameter β_4 (standard errors are in parentheses). The last column reports the minimized value of the Generalized Method of Moments objective function (significance levels for the overidentification test are in parentheses).

The instruments are the following:
Z1 - 8 dummies for marital status, sex, race, family with children, singles and composition of earners in the household;
Z2 - Z1 + 3 education dummies and education dummies interacted with age;
Z3 - 6 occupation dummies and occupation dummies interacted with age;
Z4 - education and occupation dummies interacted with age;
Z5 - Z3 + Z1 ;
Z6 - all instruments;
Z7 - lagged income in logs.

Table 8

Strictly Nondurable Consumption and Predictable Income Changes

Instruments List	Predicted ΔlnY		2SIV	2-step	OVERID Test
	Adj R^2	F value (p value)	β_4 (s.e.)	β_4 (s.e.)	Min M_n
Z1	0.003	6.504 (0.0001)	0.177 (0.247)	0.243 (0.232)	3.978 (0.782)
Z2	0.005	6.291 (0.0001)	0.359 (0.184)	0.389 (0.187)	8.653 (0.798)
Z3	0.007	10.023 (0.0001)	0.313 (0.159)	0.382 (0.160)	10.578 (0.479)
Z4	0.009	9.515 (0.0001)	0.434 (0.144)	0.496 (0.148)	10.065 (0.815)
Z5	0.009	7.990 (0.0001)	0.338 (0.142)	0.382 (0.134)	15.667 (0.679)
Z6	0.010	7.922 (0.0001)	0.409 (0.131)	0.458 (0.138)	15.461 (0.799)
Z7	0.030	525.540 (0.0001)	0.102 (0.125)	0.063 (0.062)	-

This table reports estimates of equation (11) in the text using consumption data from the CES and income data from the PSID. The statistics in colums 2 and 3 are the adjusted R^2 and F values (significance levels are in parentheses) from regressions of income changes on the instruments listed in column 1. Columns 4 and 5 report 2SIV and 2-step estimates of the parameter β_4 (standard errors are in parentheses). The last column reports the minimized value of the Generalized Method of Moments objective function (significance levels for the overidentification test are in parentheses).

The instruments are the following:
Z1 = 8 dummies for marital status, sex, race, family with children, singles and composition of earners in the household;
Z2 = Z1 + 3 education dummies and education dummies interacted with age;
Z3 = 6 occupation dummies and occupation dummies interacted with age;
Z4 = education and occupation dummies interacted with age;
Z5 = Z3 + Z1 ;
Z6 = all instruments;
Z7 = lagged income in logs.

Table 9

Food Consumption and Predictable Income Changes

Instruments List	Predicted ΔlnY		2SIV	2-step	OVERID Test
	Adj R^2	F value (p value)	β_4 (s.e.)	$\beta 4$ (s.e.)	Min M_n
Z1	0.003	6.504 (0.0001)	0.390 (0.321)	0.441 (0.308)	9.587 (0.213)
Z2	0.005	6.291 (0.0001)	0.443 (0.236)	0.453 (0.241)	13.095 (0.440)
Z3	0.007	10.023 (0.0001)	0.339 (0.205)	0.419 (0.207)	9.882 (0.541)
Z4	0.009	9.515 (0.0001)	0.511 (0.179)	0.606 (0.192)	13.323 (0.577)
Z5	0.009	7.990 (0.0001)	0.351 (0.180)	0.405 (0.174)	19.920 (0.399)
Z6	0.010	7.922 (0.0001)	0.425 (0.161)	0.516 (0.178)	21.541 (0.426)
Z7	0.030	525.540 (0.0001)	0.253 (0.160)	0.155 (0.080)	-

This table reports estimates of equation (11) in the text using consumption data from the CES and income data from the PSID. The statistics in colums 2 and 3 are the adjusted R^2 and F values (significance levels are in parentheses) from regressions of income changes on the instruments listed in column 1. Columns 4 and 5 report 2SIV and 2-step estimates of the parameter β_4 (standard errors are in parentheses). The last column reports the minimized value of the Generalized Method of Moments objective function (significance levels for the overidentification test are in parentheses).

The instruments are the following:
Z1 - 8 dummies for marital status, sex, race, family with children, singles and composition of earners in the household;
Z2 - Z1 + 3 education dummies and education dummies interacted with age;
Z3 - 6 occupation dummies and occupation dummies interacted with age;
Z4 - education and occupation dummies interacted with age;
Z5 - Z3 + Z1 ;
Z6 - all instruments;
Z7 - lagged income in logs.

Table 10

Comparison of Estimates Between CES and CES-PSID Data

Inst. List	Nondurable Cons.		Strictly Nond. Cons.		Food Consumption	
	CES	CES-PSID	CES	CES-PSID	CES	CES-PSID
Z1	-0.209 (0.184)	0.032 (0.245)	-0.042 (0.171)	0.177 (0.247)	-0.002 (0.220)	0.390 (0.321)
Z2	-0.033 (0.144)	0.198 (0.183)	0.116 (0.143)	0.359 (0.184)	0.116 (0.184)	0.443 (0.236)
Z3	0.002 (0.135)	0.182 (0.159)	0.089 (0.134)	0.313 (0.159)	0.262 (0.177)	0.339 (0.205)
Z4	0.138 (0.125)	0.334 (0.146)	0.202 (0.126)	0.434 (0.144)	0.387 (0.170)	0.511 (0.179)
Z5	-0.090 (0.114)	0.213 (0.142)	0.027 (0.111)	0.338 (0.142)	0.112 (0.144)	0.351 (0.180)
Z6	0.003 (0.105)	0.280 (0.133)	0.105 (0.104)	0.409 (0.131)	0.206 (0.136)	0.425 (0.161)
Z7	0.026 (0.019)	0.135 (0.123)	0.019 (0.019)	0.102 (0.125)	0.048 (0.025)	0.253 (0.160)

This table reports estimates of the parameter β_4 in equation (11) using CES data and CES-PSID data. Standard errors are in parentheses.

The variables used to estimate income changes are the following:
Z1 - 8 dummies for marital status, sex, race, families with children, singles, composition of earners in the household;
Z2 - Z1 + 3 education dummies and education dummies interacted with age;
Z3 - 6 occupation dummies and occupation dummies interacted with age;
Z4 - education and occupation dummies interacted with age;
Z5 - Z3 + Z1;
Z6 - all instruments;
Z7 - lagged income in logs.

Table 11

Comparison of Estimates Across CES-PSID Samples

Inst. List	Nondurable Consumption			Strictly Nond. Consumption			Food Consumption		
	1	2	3	1	2	3	1	2	3
Z1	0.032 (0.245)	0.101 (0.215)	0.062 (0.219)	0.177 (0.247)	0.164 (0.214)	0.160 (0.216)	0.390 (0.321)	0.415 (0.270)	0.126 (0.277)
Z2	0.198 (0.183)	0.203 (0.161)	0.192 (0.175)	0.359 (0.184)	0.262 (0.158)	0.266 (0.172)	0.443 (0.236)	0.329 (0.182)	0.250 (0.219)
Z3	0.182 (0.159)	0.115 (0.136)	0.151 (0.143)	0.313 (0.159)	0.216 (0.134)	0.227 (0.141)	0.339 (0.205)	0.251 (0.173)	0.282 (0.181)
Z4	0.334 (0.146)	0.264 (0.123)	0.287 (0.133)	0.434 (0.144)	0.300 (0.119)	0.300 (0.129)	0.511 (0.179)	0.425 (0.146)	0.398 (0.156)
Z5	0.213 (0.142)	0.181 (0.121)	0.205 (0.126)	0.338 (0.142)	0.280 (0.118)	0.282 (0.123)	0.351 (0.180)	0.306 (0.150)	0.308 (0.156)
Z6	0.280 (0.133)	0.242 (0.114)	0.250 (0.121)	0.409 (0.131)	0.290 (0.110)	0.275 (0.117)	0.425 (0.161)	0.365 (0.135)	0.340 (0.143)
Z7	0.135 (0.123)	0.233 (0.137)	0.121 (0.136)	0.102 (0.125)	0.146 (0.137)	0.029 (0.132)	0.253 (0.160)	0.356 (0.179)	0.266 (0.175)

This table reports estimates of the parameter β_4 in equation (11) in the text using CES-PSID data. Standard errors are in parentheses. In the first case, I consider data from the selected CES sample and the PSID sample; the number of observations are respectively 9,568 and 14,665. In the second case, I consider the enlarged CES sample and the same PSID sample; the number of observations are 13,744 and 14665. In the third case, I exclude households above the age of 65 in both samples; the number of observations are 10,846 and 12,314.

The variables used to estimate income changes are the following:

Z1 - 8 dummies for marital status, sex, race, families with children, singles, composition of earners in the household;
Z2 - Z1 + 3 education dummies and education dummies interacted with age;
Z3 - 6 occupation dummies and occupation dummies interacted with age;
Z4 - education and occupation dummies interacted with age;
Z5 - Z3 + Z1;
Z6 - all instruments;
Z7 - lagged income in logs.

Figure 1

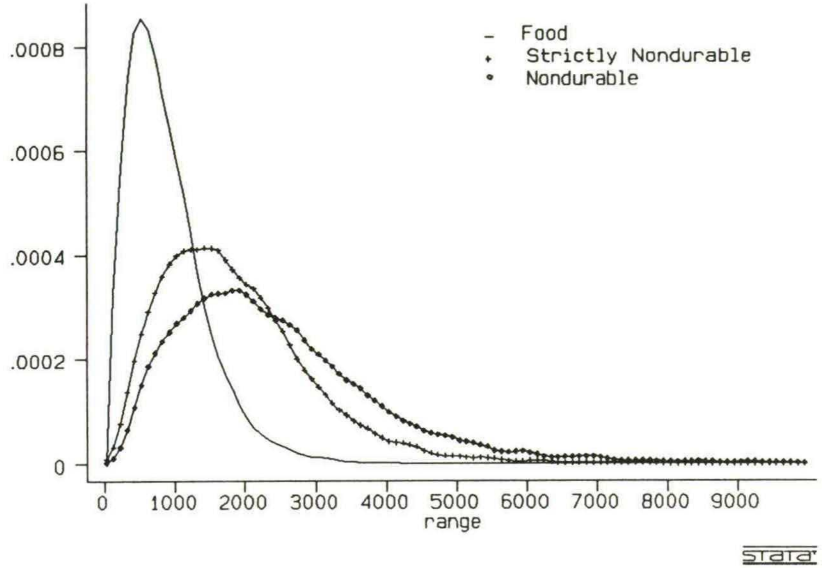

Food
Strictly Nondurable
Nondurable
.0008
.0006
.0004
.0002
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
range
stata

FIGURE 2

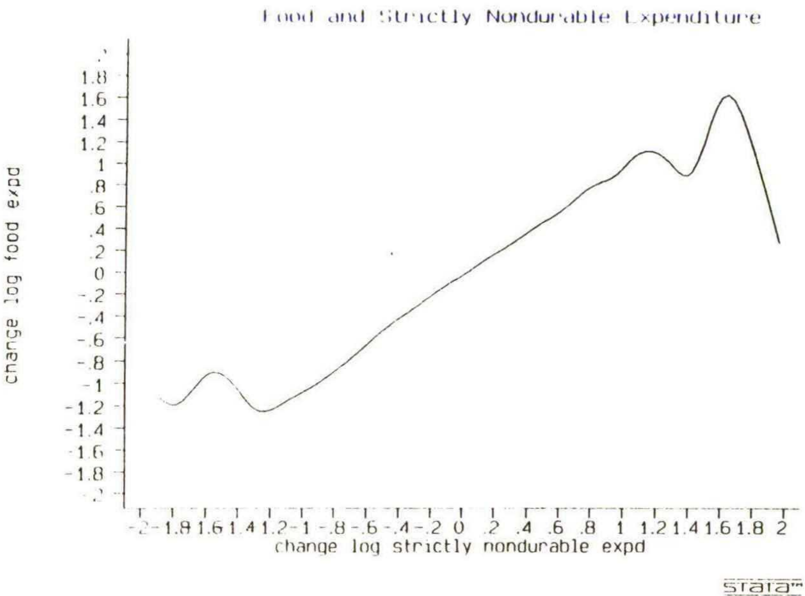
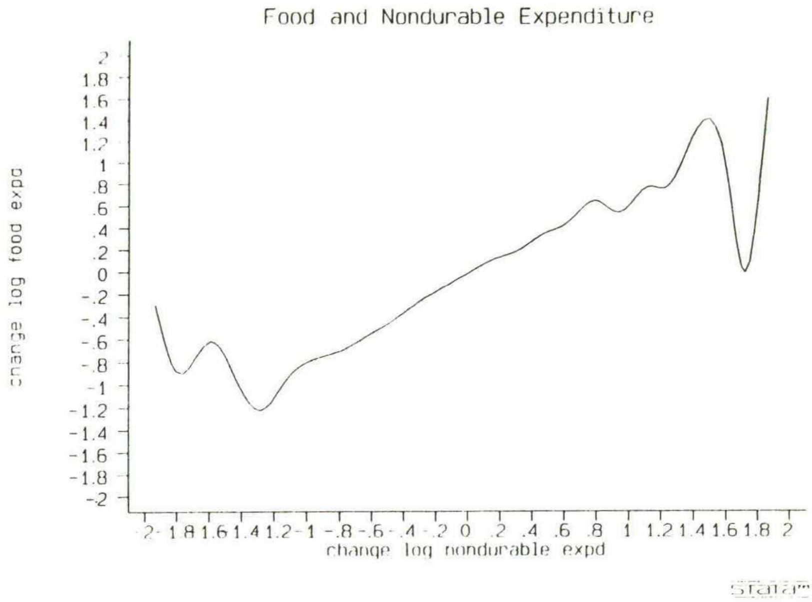

Food and Strictly Nondurable Expenditure
change log food expd
change log strictly nondurable expd
stata

FIGURE 3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